

Generalizing Android with Low-Cost 64-Bit ARM-Based Community Boards

Khasim Syed Mohammed



Android from just phones to almost everything



PHONES



TABLETS



ANDROID
WEAR

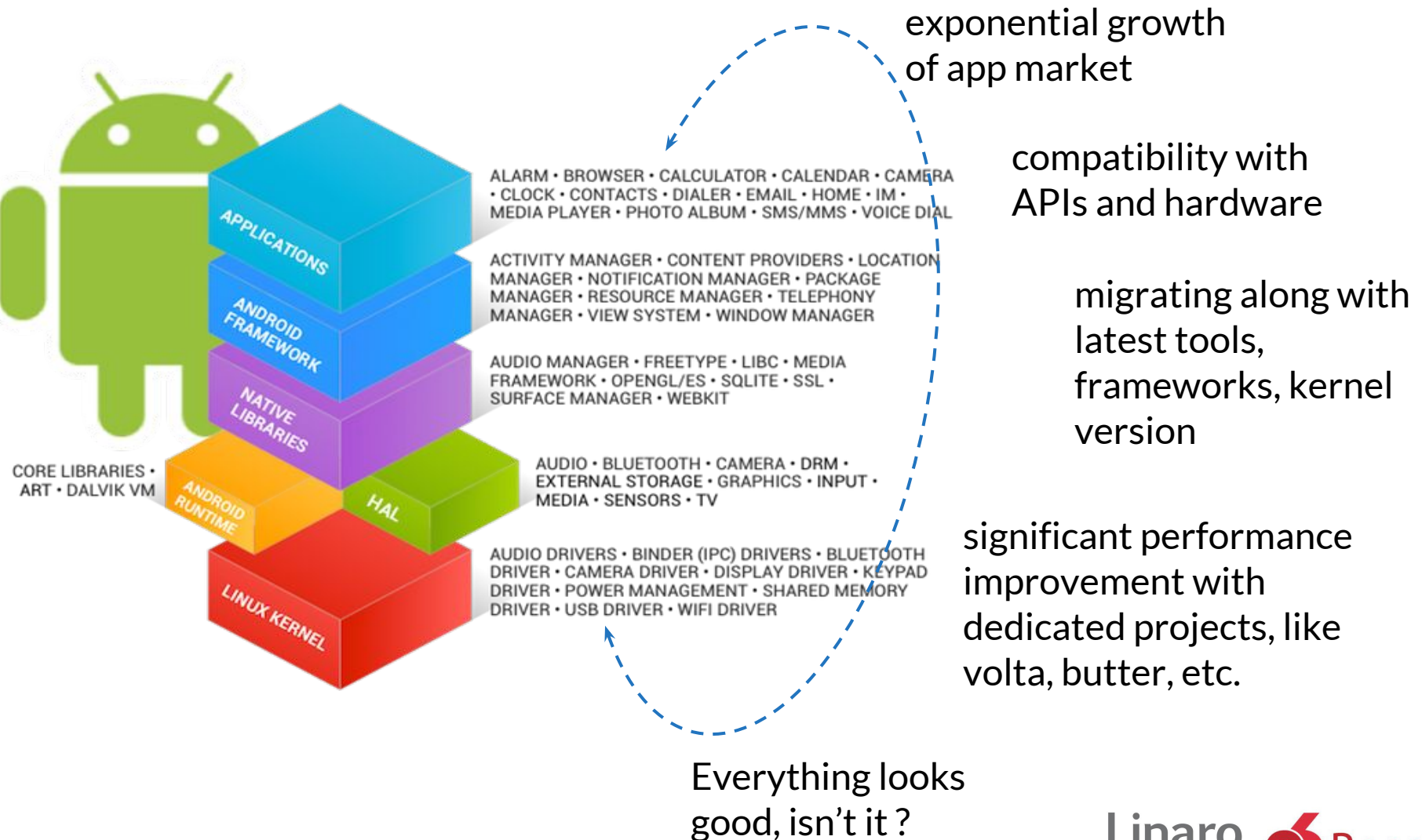


ANDROID TV



ANDROID AUTO

Android software blocks - Good job



Introducing ... “the problem”



Objective of HAL : Abstract out different methods of programming or handling hardware.

Should be a very thin C source file, to map Android interfaces to kernel ABIs

Same HAL to be used across similar devices from multiple vendors

Who works with HAL

SOC Vendors :

- Distributed mostly through private repositories directly to OEM/ODM
- Validated and Supported on their own SOC based platforms.
- Max one working example per peripheral available on hardware platform
- Kernel version might / might not align with LSK or AOSP kernel

Android Team @ Google : AOSP

- HAL changes to meet Nexus device needs.
- Available as part of AOSP

Chipset Vendors

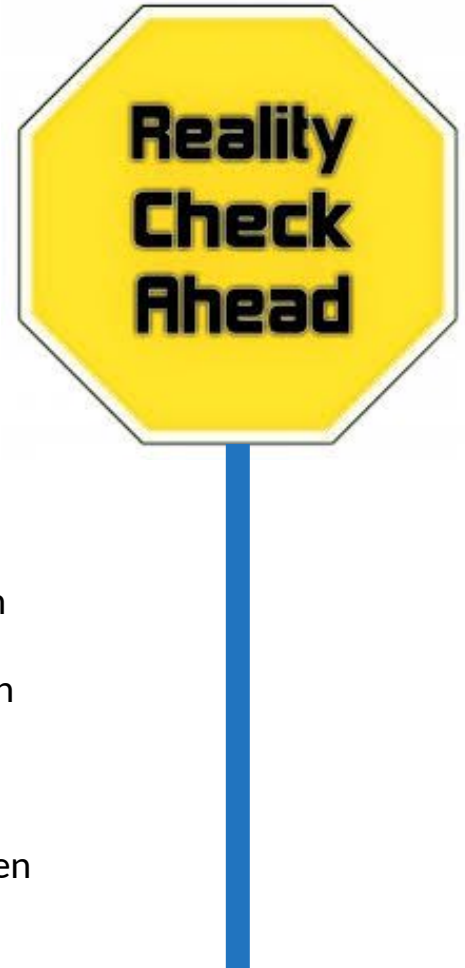
- Like Audio, Connectivity, Camera sensor, etc.
- If popular, then generally these devices are part of vendor distribution or on AOSP if part of Nexus
- Very rarely found on vendor specific repositories like what Wolfson did with [TinyALSA](#)

OEM / ODM / Product makers

- Very few give out actual sources, so most of the work is proprietary or hidden

Community, 3rd parties to all of the above, etc.

- Like Cynogenmod maintains the sources for different HAL.
- Few 3rd parties do actual development but no sources gets public.



Top 3 findings to discuss

- The HAL layer has not grown in AOSP, which is good.
 - But the one there still doesn't support the device I need.
- Sources on AOSP != Sources from Vendors
 - The hardware (HAL) folder has different files, modified from original version, customized and lot more.
- HAL implemented for a device, doesn't work on another similar device type.
 - hardware initialization mismatch, different data handling logic.
 - Kernel version, Android version changes.

Some investigation ...

- **No open source collaboration for HALs**
 - Though everyone has very similar hardware programming requirements.
 - Spending heavily on efforts in migrating and maintaining for new Android and kernel versions.
- **Random customizations in HAL for differentiations**
 - Resulting in very limited improvements on kernel (IOCTLS, API) interfaces.
 - Example: Camera.
- **Vendor proprietary binary only libraries still exists in user space.**
 - No standards defined or followed. Reason : all modes not supported.
 - Example: GPS, Sensors
- **Similar Hardware but configured differently**
 - Each vendor has different initialization sequence to follow implemented in HAL, Example: Bluetooth, Sensors, etc.

**Pretend
as if not an issue**

Keep Looping



Generalize HAL

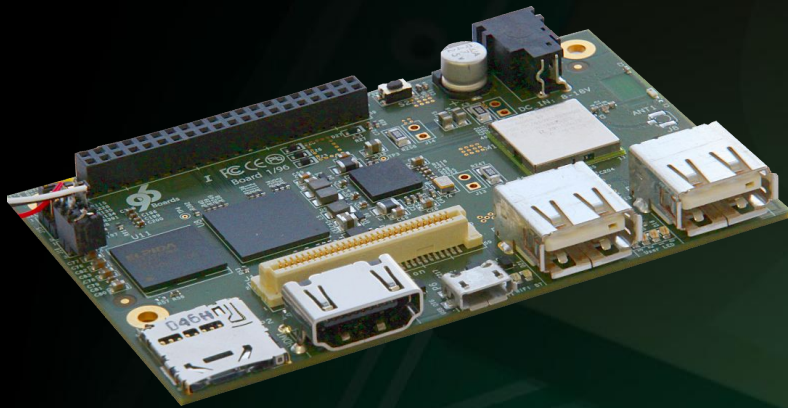
96boards.org



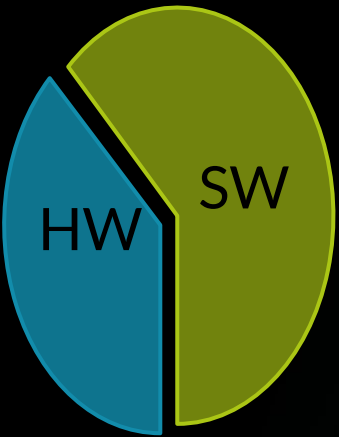
World with “Generalized” HAL

- **Bring in the Open Source culture for HAL on AOSP**
 - Discuss HAL generalization patches on AOSP and start submitting patches on HAL.
- **Reduce customizations in HAL for differentiations**
 - Add support for new features and functionalities in Kernel drivers.
Example: Add more V4L APIs for Camera
 - Identify the best data organizing, buffer handling / management policies / options and pick one for all similar device types Example ION ? for Camera
 - Initialized and configure hardware using predefined values from xml files
- **Reduce HAL to single C source file that works for multiple devices of same type**
 - Link proprietary firmware with HAL over a standard call back interface.
 - Example: Bluetooth, Sensors, etc.
- **Request for AOSP version of Media framework / SOC vendor specific changes**
 - Provide more features as required as a set of extra patches to AOSP.

www.96Boards.org

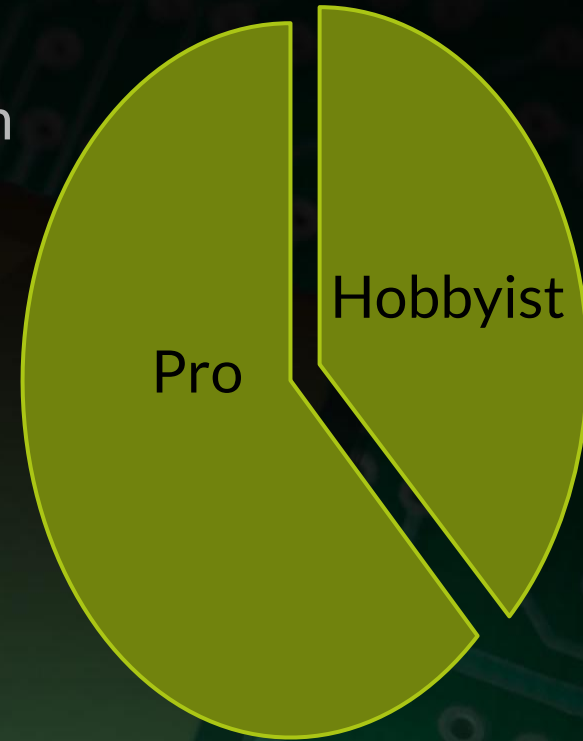


Target Markets



Software >60%
of cost of SoC
development**

- ▣ Commercial & higher education software development
- ▣ OEM/ODMs - for IoT, mobile, compute, enterprise
- ▣ Maker market - Robotics, UAV, HPC, etc



20 million SW
developers globally*

Sources: *IDC 2013,
**ITRS 2007, **IBS 2009

Why 96Boards?

- ▣ Low-cost access to ARM including 64-bit ARMv8
- ▣ A single hardware ecosystem for expansion across multiple vendors with long-term compatibility
- ▣ A single community, sharing solutions
- ▣ Open for all developers
- ▣ Base software maintained by Linaro



Two Open 96Boards Specifications



- ▣ Low cost ~\$50-150
- ▣ Mobile/Embedded SoCs
- ▣ For software developers, maker community, research, universities & OEMs



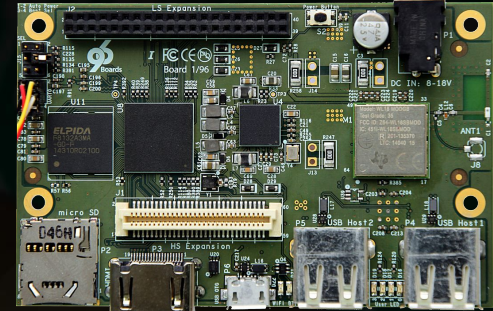
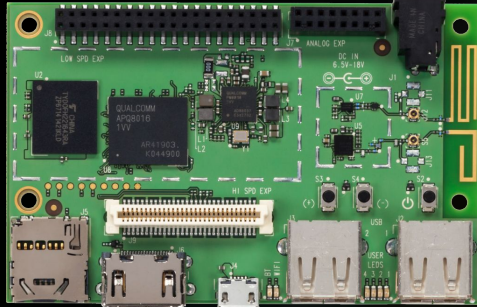
- ▣ Low cost ~\$300
- ▣ Server/Networking SoCs
- ▣ For software developers, universities & research, SoC evaluation and test/build farms

96Boards Consumer Edition Goals

- ▣ An SoC independent low cost platform
 - ◆ Develop a larger hardware ecosystem & enable longer platform life
 - ◆ Reduce costs of embedded product development
 - ◆ Enable vendor differentiation
- ▣ Enable low cost (\$50-150 MSRP) community boards
- ▣ Delivery of a small form factor physical design
 - ◆ Standardized footprint
 - ◆ User connectors/access on front edge only
 - ◆ Small form factor (85 x 54 x 12mm total) with very low profile (7mm board to board separation), suitable for embedded product use

Added Value for Distribution

- ▣ 96Boards is a long-term platform not a single product
 - ◆ Multiple boards in development
 - ◆ A single community = A larger opportunity for mezzanine boards and modules for many markets - e.g. Robots, UAV, Smart Displays, White goods etc.
- ▣ Vendors building 96Boards products are likely to re-use peripheral components
 - ◆ WiFi/Bluetooth, USB hub, DSI-HDMI etc., Sensors, IoT devices etc.
- ▣ 96Boards is a platform to demonstrate peripheral chips and devices that can work on any 96Boards product



Name

DragonBoard 410c

HiKey

CPU

Qualcomm®
SnapDragon™ 400
Quad-core Cortex-
A53

HiSilicon Kirin 6220
Octa-core Cortex-A53

GPU

Adreno 306

Mali 450-MP4

Qualcomm® DragonBoard 410c Multi-Linux OS support

Linux Android L and Ubuntu support will be available at launch

Mainline Linux Support

- Linaro Linux release based on current Linux kernel and Ubuntu
- Ongoing active effort to submit support upstream
- Goal to achieve full upstream support for this board

Open Source Graphics

- Open Source “Freedreno” driver available for Qualcomm® Adreno™ 306 400MHz PC class
- Support for standard graphics desktop such as Gnome-shell
- Upstream DRM/KMS driver
- Open GL, Open GL ES 3.0

64-bit capable

- One of the world’s first high performance, 64-bit capable, low cost ARM based platforms
- Ideal for Linux Developers interested in 64-bit development

More OS support will be added later – Ubuntu Snappy, Open Embedded, Fedora

What does Linaro do?

- ▣ Members fund Linaro's 220 OSS engineers to develop software collaboratively
- ▣ Software is built once and shared by all
- ▣ Work is open, tested and upstreamed



Linaro Core & Club Members



Plus 15 Group Members

ACKNOWLEDGEMENTS

Thanks to Android team on projectara for sharing all the insights on HAL generalization.

HAL generalization patches from projectara program will be discussed on AOSP mailing lists.

Join 96boards.org and
discuss
HAL generalization

thankyou